Vasopressors and inotropes in treatment of acute hypotensive states and shock: Adult dose and selected characteristics

Agent	US trade name	Initial dose	Usual maintenance dose range	Range of maximum doses used in refractory shock	Role in therapy and selected characteristics
Vasopressors (alpha-1 adrenergic)					
Norepinephrine (noradrenaline)	Levophed	8 to 12 mcg/minute (0.1 to 0.15 mcg/kg/minute) A lower initial dose of 5 mcg/minute may be used, eg, in older adults	2 to 4 mcg/minute (0.025 to 0.05 mcg/kg/minute)	35 to 100 mcg/minute (0.5 to 0.75 mcg/kg/minute; up to 3.3 mcg/kg/minute has been needed rarely)	▪ Initial vasopressor of choice in septic, cardiogenic, and hypovolemic shock. ▪ Wide range of doses utilized clinically. ▪ Must be diluted; eg, a usual concentration is 4 mg in 250 mL of D5W or NS (16 micrograms/mL).
Epinephrine (adrenaline)	Adrenalin	1 mcg/minute (0.014 mcg/kg/minute)	1 to 10 mcg/minute (0.014 to 0.14 mcg/kg/minute)	10 to 35 mcg/minute (0.14 to 0.5 mcg/kg/minute)	▪ Initial vasopressor of choice in anaphylactic shock. ▪ Typically an add-on agent to norepinephrine in septic shock when an additional agent is required and occasionally an alternative first-line agent if norepinephrine is contraindicated. ▪ Increases heart rate; may induce tachyarrhythmias and ischemia. ▪ Elevates lactate concentrations during initial administration (ie, may preclude use of lactate clearance goal); may decrease mesenteric perfusion. ▪ Must be diluted; eg, a usual concentration is 1 mg in 250 mL D5W (4 micrograms/mL).
Phenylephrine	Neo-Synephrine, Vazculep	100 to 180 mcg/minute until stabilized (alternatively, 0.5 to 2 mcg/kg/minute)	20 to 80 mcg/minute (0.25 to 1.1 mcg/kg/minute)	80 to 360 mcg/minute (1.1 to 6 mcg/kg/minute); Doses >6 mcg/kg/minute do not increase efficacy according to product information in the United States	▪ Pure alpha-adrenergic vasoconstrictor. ▪ Initial vasopressor when tachyarrhythmias preclude use of norepinephrine. ▪ Alternative vasopressor for patients with septic shock who: (1) develop tachyarrhythmias on norepinephrine, (2) have persistent shock despite use of two or more vasopressor/inotropic agents including vasopressin (salvage therapy), or (3) high cardiac output with persistent hypotension. ▪ May decrease stroke volume and cardiac output in patients with cardiac dysfunction. ▪ May be given as bolus dose of 50 to100 micrograms to support blood pressure during rapid sequence intubation. ▪ Must be diluted; eg, a usual concentration is 10 mg in 250 mL D5W or NS (40 micrograms/mL).
Dopamine	Inotropin	2 to 5 mcg/kg/minute	5 to 20 mcg/kg/minute	20 to >50 mcg/kg/minute	▪ A second-line agent to norepinephrine in highly selected patients (ie, low risk of tachyarrhythmias or bradycardia induced hypotension). ▪ More adverse effects (eg, tachycardia, arrhythmias particularly at doses ≥20 mcg/kg/minute) and failed therapy than norepinephrine. ▪ May be useful in selected patients (eg, with compromised systolic function or bradycardia at low risk for tachyarrhythmias). ▪ Lower doses (eg, 1 to 3 mcg/kg/minute) should not be used for renal protective effect and can cause hypotension during weaning. ▪ Must be diluted; eg, a usual concentration is 400 mg in 250 mL D5W (1.6 mg/mL); use of a commercially available pre-diluted solution is preferred.
Antidiuretic hormone					
Vasopressin (arginine-vasopressin)	Pitressin, Vasostrict	0.03 units per minute (alternatively 0.01 to 0.03 units/minute initially)	0.03 to 0.04 units per minute (not titrated)	0.04 to 0.07 units/minute; Doses >0.04 units/minute can cause cardiac ischemia and	▪ Add-on to another vasopressor (eg, norepinephrine) to augment efficacy and decrease initial vasopressor requirement. Not recommended as a replacement for a first-line vasopressor. ▪ Pure vasoconstrictor; may decrease stroke volume and cardiac output in myocardial dysfunction or precipitate

				should be reserved for salvage therapy	ischemia in coronary artery disease. ▪ Must be diluted; eg, a usual concentration is 25 units in 250 mL D5W or NS (0.1 units/mL).
Inotrope (beta$_1$ adrenergic)					
Dobutamine	Dobutrex	0.5 to 1 mcg/kg/minute (alternatively, 2.5 mcg/kg/minute in more severe cardiac decompensation)	2 to 20 mcg/kg/minute	20 to 40 mcg/kg/minute; Doses >20 mcg/kg/minute are not recommended in heart failure and should be reserved for salvage therapy	▪ Initial agent of choice in cardiogenic shock with low cardiac output and maintained blood pressure. ▪ Add-on to norepinephrine for cardiac output augmentation in septic shock with myocardial dysfunction (eg, in elevated left ventricular filling pressures and adequate MAP) or ongoing hypoperfusion despite adequate intravascular volume and MAP. ▪ Increases cardiac contractility and rate; may cause hypotension and tachyarrhythmias. ▪ Must be diluted; a usual concentration is 250 mg in 500 mL D5W or NS (0.5 mg/mL); use of a commercially available pre-diluted solution is preferred.
Inotrope (nonadrenergic, PDE$_3$ inhibitor)					
Milrinone	Primacor	Optional loading dose: 50 mcg/kg over 10 minutes (usually not given)	0.125 to 0.75 mcg/kg/minute		▪ Alternative for short-term cardiac output augmentation to maintain organ perfusion in cardiogenic shock refractory to other agents. ▪ Increases cardiac contractility and modestly increases heart rate at high doses; may cause peripheral vasodilation, hypotension, and/or ventricular arrhythmia. ▪ Renally cleared; dose adjustment in renal impairment needed. ▪ Must be diluted; eg, a usual concentration is 40 mg in 200 mL D5W (200 micrograms/mL); use of a commercially available pre-diluted solution is preferred.

- All doses shown are for intravenous (IV) administration in adult patients. The initial doses shown in this table may differ from those recommended in immediate post-cardiac arrest management (ie, advanced cardiac life support). For details, refer to the UpToDate topic review of post-cardiac arrest management in adults, section on hemodynamic considerations.
- Vasopressors can cause life-threatening hypotension and hypertension, dysrhythmias, and myocardial ischemia. They should be administered by use of an infusion pump adjusted by clinicians trained and experienced in dose titration of intravenous vasopressors using continuous noninvasive electronic monitoring of blood pressure, heart rate, rhythm, and function. Hypovolemia should be corrected prior to the institution of vasopressor therapy. Reduce infusion rate gradually; avoid sudden discontinuation.
- Vasopressors can cause severe local tissue ischemia; central line administration is preferred. When a patient does not have a central venous catheter, vasopressors can be temporarily administered in a low concentration through an appropriately positioned peripheral venous catheter (ie, in a large vein) until a central venous catheter is inserted. The examples of concentrations shown in this table are useful for peripheral (short-term) or central line administration. Closely monitor catheter site throughout infusion to avoid extravasation injury. In event of extravasation, prompt local infiltration of an antidote (eg, phentolamine, if available) may be useful for limiting tissue ischemia. Stop infusion and refer to extravasation management protocol.
- Vasopressor infusions are high-risk medications requiring caution to prevent a medication error and patient harm. To reduce the risk of making a medication error, we suggest that centers have available protocols that include steps on how to prepare and administer vasopressor infusions using a limited number of standardized concentrations. Examples of concentrations and other detail are based on recommendations used at experienced centers; protocols vary.

D5W: 5% dextrose water; MAP: mean arterial pressure; NS: 0.9% saline.

Data from:

1. *Dellinger RP, Levy MM, Rhodes A, et al. Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock: 2012. Crit Care Med 2013; 41:580.*
2. *Hollenberg SM. Vasoactive drugs in circulatory shock. Am J Respir Crit Care Med 2011; 183:847.*

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